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TECHNICAL PROGRESS REPORT

JANUARY 1994

DEVELOP ADVANCED NONLINEAR SIGNAL ANALYSIS TOPOGRAPHICAL MAPPING SYSTEM

NASA CONTRACT NO. NAS8-39393

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MARSHALL SPACE FLIGHT CENTER, AL 35812

by

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AI SIGNAL RESEARCH TECHNICAL REPORT TR-4002-94-01

AI SIGNAL RESEARCH

Program Manager: J. Jong

NASA

Contract Monitor: J. Jones
Contracting Officer: L. Van Wagner

DEVELOP ADVANCED NONLINEAR SIGNAL ANALYSIS TOPOGRAPHICAL MAPPING SYSTEM
(NASA CONTRACT NO. NAS8-39393)

The SSME has been undergoing extensive flight certification and developmental testing, which involves some 250 health monitoring measurements. Under the severe temperature, pressure, and dynamic environments sustained during operation, numerous major component failures have occurred, resulting in extensive engine hardware damage and scheduling losses. To enhance SSME safety and reliability, detailed analysis and evaluation of the measurements signal are mandatory to assess its dynamic characteristics and operational condition. Efficient and reliable signal detection techniques will reduce catastrophic system failure risks and expedite the evaluation of both flight and ground test data, and thereby reduce launch turn-around time.

The basic objective of this contract are threefold:

(1) Develop and validate a hierarchy of innovative signal analysis techniques for nonlinear and nonstationary time-frequency analysis. Performance evaluation will be carried out through detailed analysis of extensive SSME static firing and flight data. These techniques will be incorporated into a fully automated system.

(2) Develop an advanced nonlinear signal analysis topographical mapping system (ATMS) to generate a Compressed SSME TOPO Data Base (CSTDB). This ATMS system will convert tremendous amount of complex vibration signals from the entire SSME test history into a bank of succinct image-like patterns while retaining all respective phase information. High compression ratio can be achieved to allow minimal storage requirement, while providing fast signature retrieval, pattern comparison, and identification capabilities.

(3) Integrate the nonlinear correlation techniques into the CSTDB data base with compatible TOPO input data format. Such integrated ATMS system will provide the large test archives necessary for quick signature comparison.

This study will provide timely assessment of SSME component operational status, identify probable causes of malfunction, and indicate feasible engineering solutions. The final result of this program will yield an ATMS system of nonlinear and nonstationary spectral analysis software package integrated with the Compressed SSME TOPO Data Base (CSTDB) on the same platform. This system will allow NASA engineers to retrieve any unique defect signatures and trends associated with different failure modes and anomalous phenomena over the entire SSME test history across turbopump families.

REPORTS

In addition to monthly technical progress reports, informal analysis results of SSME test are prepared and presented at irregular intervals. Software routines and database are provided for application on MSFC computers. The final report will document all analysis results, new techniques and computer software generated under this contract.

TECHNICAL PROGRESS

This is January 1994 monthly technical progress report on the subject contract for the development of an advanced nonlinear signal analysis topographical mapping system (ATMS) for SSME diagnostic evaluation. Specific tasks performed in this reporting period are summarized as follows:

(1) A presentation for annual contract progress review was given to MSFC ED-23 personnel on January 21, 1994 to discuss and update the current software development effort for the Advanced Topo Mapping System (ATMS). A number of major contract performance and plans were discussed in the presentation. In reviewing the 1993 contract accomplishment, the development of three new signal analysis techniques for ATMS system were discussed in detailed. These include a signal enhancement method and two time delay estimation methods. Simulation examples along with real test applications were shown to demonstrate the principle and effectiveness of each techniques. In addition, several anomaly/failure investigation effert performed in 1993 were reviewed. Two major anomaly inestigation efforts relating to the ATD HPOP Unit 2-3 failure, and the ATD high sync spike anomaly investigation were discussed. These anomaly/failure investigation provide the best opportunity for performance evaluation and software verification for the analysis programs for the ATMS system. In addition, technical progress for the ATMS development was reviewed and discussed. This include the establishment of computer & hardware, the software development for the ATMS Signal Analysis Library (ASAL) and the expert system development. Four major tasks to be accomplished in 1994 were also reviewed in the meeting. These tasks includes (1) development/refine of New analysis techniques (2) anomaly/failure investigation (3) development of AMD-Standard Analysis Driver, and (4) development of AMD-Advanced Analysis Driver. Finally, contract coordination and resources requirements for 1994 along with contract schedules and milestones were then discussed. A copy of the material presented in this meeting is enclosed.

(2) Continuous software development for the ATMS system is performed during this reporting period. The complete set of signal analysis programs to be established in the ATMS Signal Analysis Library (ASAL) have been implemented on the sun/330 workstation, which will be the development platform for the ATMS system. These software include the following advanced signal analysis programs:

. Auto/Cross Bi-Spectral Analysis (ABC)
. Auto/Cross Tri-Spectral Analysis (ATC)
. Hyper-Coherence Analysis (HCA)
. Instantaneous Frequency Correlation (IFC)

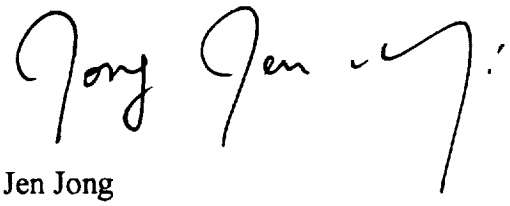
. phase slope time delay estimator (PSTDE)
. Dynamic orbit analysis (DOA)
. Static orbit analysis (SOA)
. Hyper Coherence Filtering (HCF)
. Generalized Hyper Coherence (GHC)
. Composite Modulation Analysis (CMA)
. Hilbert transform (HT)
. Envelop Detection Method (EDM)
. Kurtosis/Skewness moment tracking
. Cepstrum Analysis
. 2D Frequency/Wave-Number Spectral analysis
. Cyclic spectral Analysis
. Rotary Spectral Analysis (RSA)
. Adptive Comb/Notch Filter (ACF/ANF)
. Adaptive noise cancellation (ANC)
. Adaptive line enhancer (ALE)
. Phase Domain Average (PDA) technique
. Maximum Entropy Method Spectral analysis
. TOPO mapping algorithm
. Wigner distribution analysis

In addition, the standad utility programs: such as "backup", "merge", "resample", "filecopy", along with the standard signal analysis programs:such as "FFT", "IFFT, "PSD", isoplot", "tracking", "filter", "klincoh", have all been implemented on the system. Software verification of these programs on the SUN/330 Workstation have been performed. A number of problems associated with VA2 (Vector Accelerator) operation were identified. Software modification using non-VA2 codes to resolve these problems is currently under study. Continuous verification for the VA2 modification will be performed in the next reporting period.

The software development effort also include the implementation of the CLIPS expert system for the ATMS AMD-driver. the CLIPS. The latest version of CLIPS, which is CLIPS version 6, has been acquired and fully implemented on the Sun/330 system. The CLIPS expert system is developed by the software development branch at NASA Johnson Space Center (JSC). This expert system is a critical element for the development of ATMS AMD-Driver, which require fully integration of all the analysis programs in the ATMS Signal Analysis Library with this CLIPS expert system. Basic CLIPS operation environments and procedures have been evaluated and tested on SUN/330 system. In addition, several example runs of analysis programs supervised by CLIPS have been performed. This preliminary study indicates that CLIPS is a feasible tool for the development of the AMD-Driver whose ultimate objective is to automate the dynamic signal analysis for SSME test evaluation. Development of the

AMD-driver and its interface with the CLIPS expert system will be continued in the next reporting period.

Prepared and approved by



Jen Jong
Program Manager

1994 ANNUAL TECHNICAL PROGRESS REPORT

DEVELOP ADVANCED NONLINEAR SIGNAL ANALYSIS TOPOGRAPHICAL MAPPING SYSTEM (ATMS)

NASA CONTRACT NO. NAS8-39393

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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January 20 1994

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DEVELOP ADVANCED NONLINEAR SIGNAL ANALYSIS TOPOGRAPHICAL MAPPING SYSTEM (ATMS)

(NASA CONTRACT NO. NAS8-39393)

TOPICS:

. 1993 CONTRACT MILESTONES & ACCOMPLISHMENT:

(1) NEW SIGNAL ANALYSIS TECHNIQUES FOR ATMS SYSTEM

- PSE (PHASE SYNCHRONIZED ENHANCER) METHOD FOR SIGNAL ENHANCEMENT

- IFC (INSTANTANEOUS FREQUENCY CORRELATION) METHOD FOR TIME DELAY ESTIMATION

- PSTDE (PHASE SLOPE TIME DELAY ESTIMATOR) METHOD FOR TIME DELAY ESTIMATION FOR SIGNAL WITH LINEARLY VARYING FREQUENCY

(2) ANOMALY/FAILURE INVESTIGATION

- ATD HPOP UNIT 2-3A: DELTA-T EXCURSION ACROSS PUMP-END BALL BEARING FAILURE INVESTIGATION

- ATD HPOP HIGH SYNC SPIKE ANOMALY INVESTIGATION

(3) ATMS/EXPERT SYSTEM DEVELOPMENT

- COMPUTER & HARDWARE: SUN/330 SPARC WORKSTATION

- SOFTWARE: SIGNAL ANALYSIS PROGRAMS

- CLIPS EXPERT SYSTEM: FOR DEVELOPMENT OF AMD-DRIVER

. 1994 CONTRACT SCHEDULES & OBJECTIVES:

TASK-1. DEVELOP/REFINE OF NEW ANALYSIS TECHNIQUES

TASK-2. ANOMALY/FAILURE INVESTIGATION

TASK-3. DEVELOPMENT OF AMD-STANDARD ANALYSIS DRIVER

TASK-4. DEVELOPMENT OF AMD-ADVANCED ANALYSIS DRIVER

. COORDINATION & RESOURCE REQUIREMENTS
. SCHEDULE AND MILESTONE

NEW SIGNAL ANALYSIS TECHNIQUES FOR ATMS SYSTEM

(1) PSE (PHASE SYNCHRONIZED ENHANCER) METHOD FOR SIGNAL ENHANCEMENT

. GHC TECHNIQUE:

ESTIMATE THE INSTANTANEOUS FREQUENCY (IF) OF A SPECTRAL COMPONENT SUCH AS THE SYNC FREQUENCY COMPONENT OF SSME

. OBSERVATION FROM GHC ANALYSIS:

= = > FREQUENCY OF SYNC IS NOT A CONSTANT FREQUENCY DURING STEADY STATE OPERATION

= = > THE SYNC MOTION SHOULD BE MODELED AS A NARROW-BAND RANDOM PROCESS RATHER THAN A SINUSOIDAL WAVE

. PSE TECHNIQUE: FORCE THE NARROW-BAND RANDOM PROCESS OF SYNC INTO A SINUSOIDAL WAVE BASED ON THE INSTANTANEOUS PHASE INFORMATION

= = > ALL OTHER SPECTRAL COMPONENTS WHICH ARE CORRELATED WITH SYNC (SUCH AS SYNC HARMONICS, CAGE, OBP, IBP..) WILL AUTOMATICALLY BECOME DISCRETE

= = > SIGNAL ENHANCEMENT

NEW SIGNAL ANALYSIS TECHNIQUES FOR ATMS SYSTEM

2. IFC (INSTANTANEOUS FREQUENCY CORRELATION) METHOD FOR TIME DELAY ESTIMATION

SOURCE IDENTIFICATION OF ANOMALY: TIME DELAY ESTIMATION IS AN IMPORTANCE TASK IN MACHINERY DIAGNOSTICS

- WAVE PROPAGATION DIRECTION
- TIME LAG/LEAD INFORMATION

SSME EXAMPLES: 4000 Hz, Pseudo 3N, 12KHZ, 330 Hz Anomaly.

CONVENTIONAL METHOD:

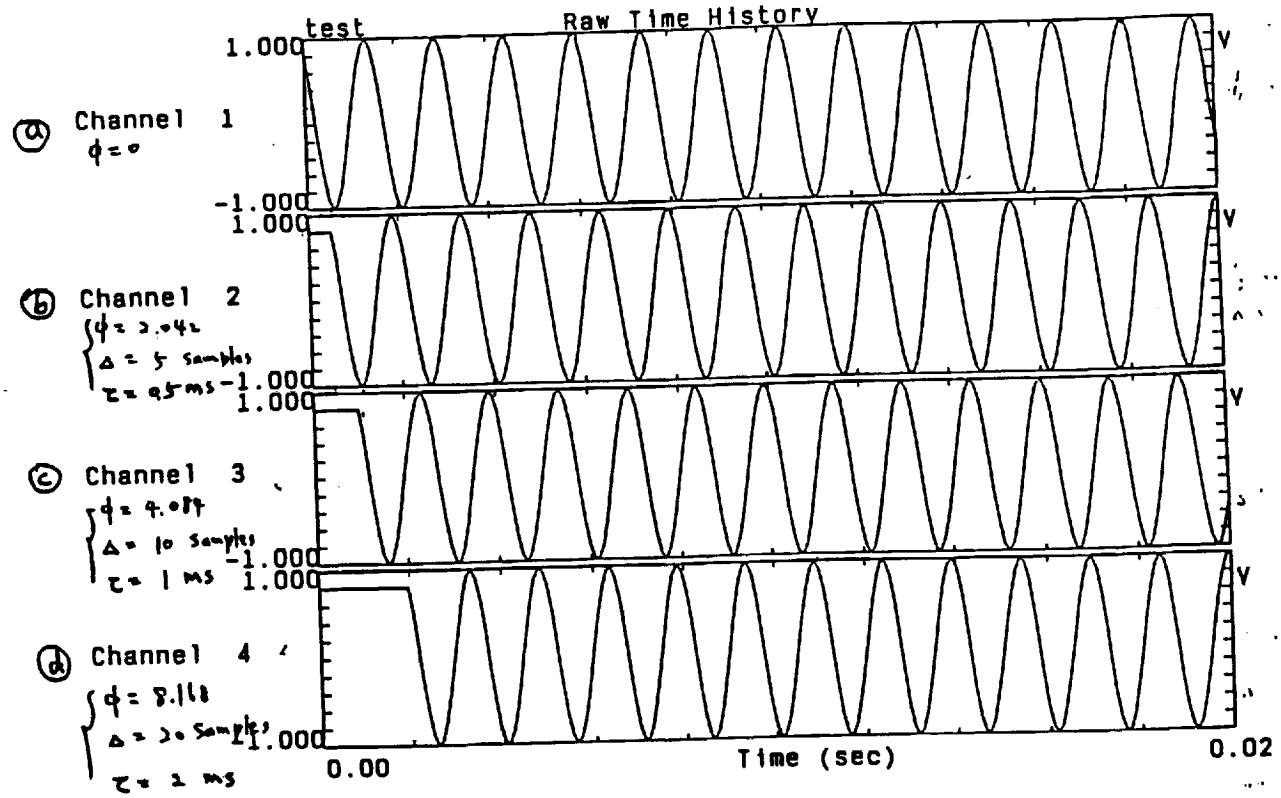
- TIME DOMAIN CROSS-CORRELATION FUNCTION
- FREQUENCY DOMAIN PHASE OF TRANSFER FUNCTION
- **LIMITATION: AMBIGUITY DUE TO PHASE WRAPPING EFFECT**

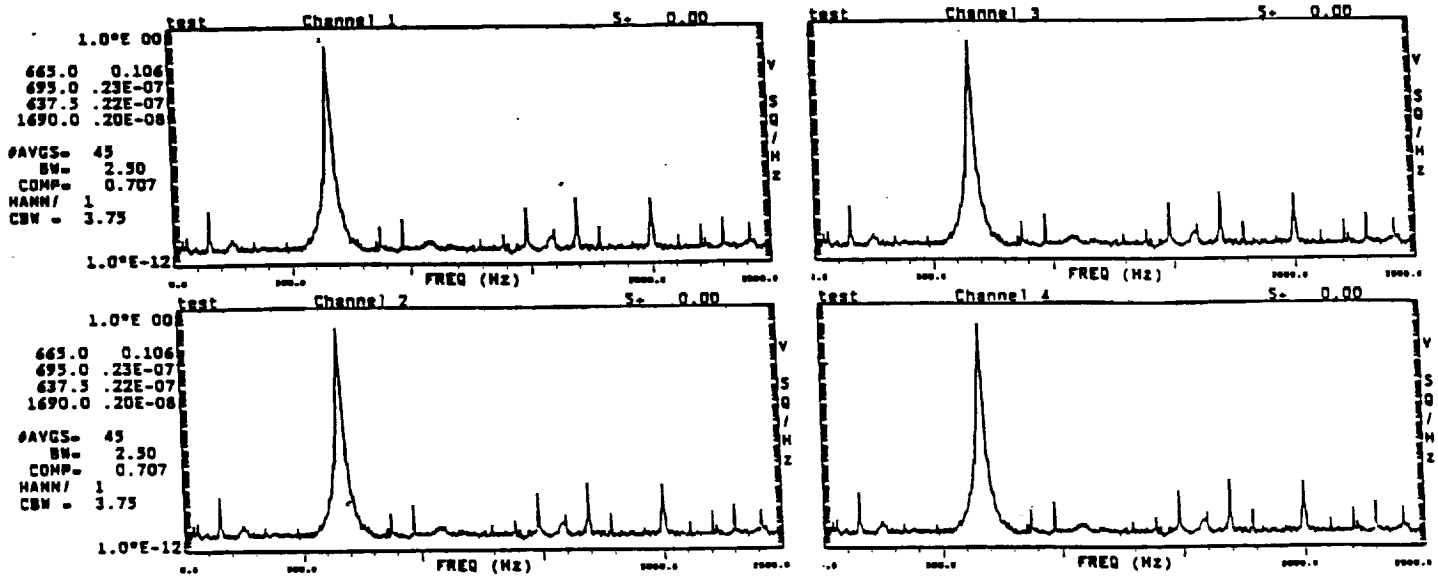
IFC (INSTANTANEOUS FREQUENCY CORRELATION) METHOD:

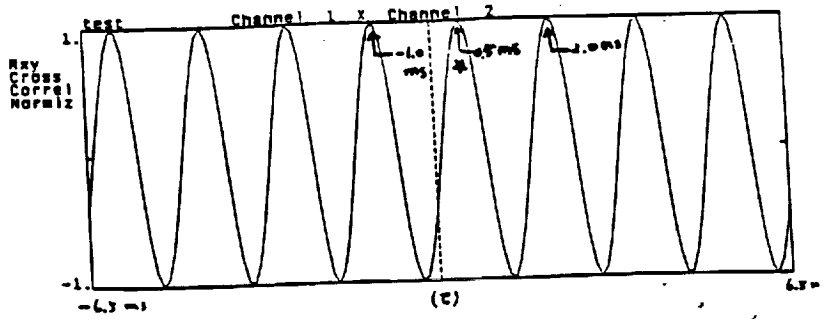
- WITHOUT SUBJECTED TO THE PHASE WRAPPING EFFECT
- TRANSFORM THE ORIGINAL TIME SIGNAL OF A SPECTRAL COMPONENT INTO ITS CORRESPONDING INSTANTANEOUS FREQUENCY (IF) SIGNAL
- TIME DELAY - BASED ON THE NEWLY GENERATED IF SIGNAL
- ADVANTAGE: PERIODIC NATURE OF THE ORIGINAL SIGNAL IS TRANSFORMED INTO A BROADBAND RANDOM NATURE OF THE IF SIGNAL
- PHASE WRAPPING EFFECT WILL BE REMOVED
- RESTRICTIVE APPLICATION CONDITION:
  - . HIGH SIGNAL-TO-NOISE RATIO
  - . LONG STATIONARY TIME PERIOD ENSEMBLE FOR AVERAGE

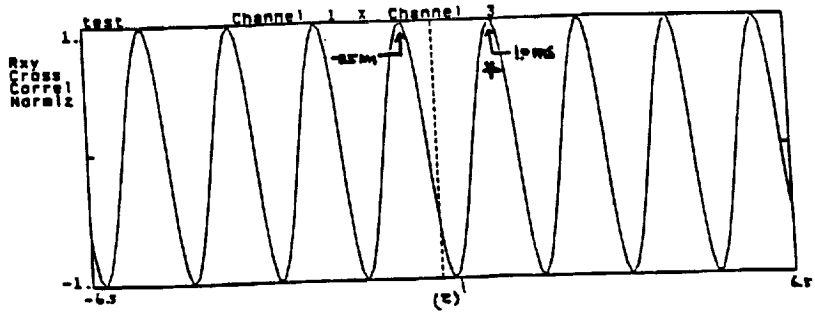
SIMULATION: SINE WAVE AT CENTER FREQUENCY 666 HZ

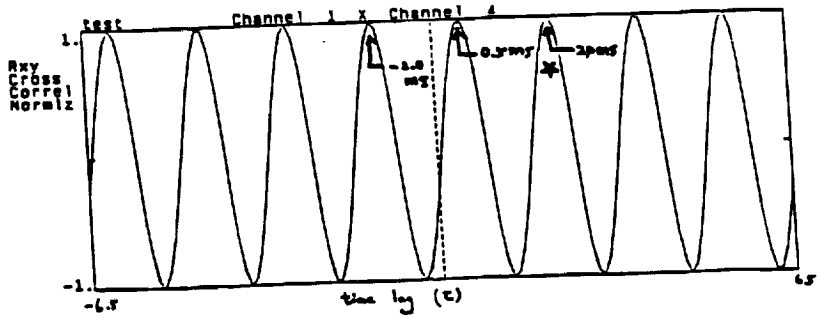
	Ch1/Ch2	Ch1/Ch3	Ch1/Ch4
Delay in samples	5	10	20
Delay in msec	0.5	1.0	2.0
Phase difference(rad)	2.042	4.084	8.168


test
Raw Time History
1.000
-1.000
V
Channel 1
Channel 2
Channel 3
Channel 4
0.00
Time (sec)
0.02


test
Channel 1
Channel 2
Channel 3
Channel 4
1.0*E 00
1.0*E-12
665.0 0.106
695.0 .23E-07
637.5 .22E-07
1690.0 .20E-08
#AVGS= 45
BW= 2.50
COMP= 0.707
HANN/ 1
CBW = 3.75
FREQ (Hz)
V
SQ/HZ



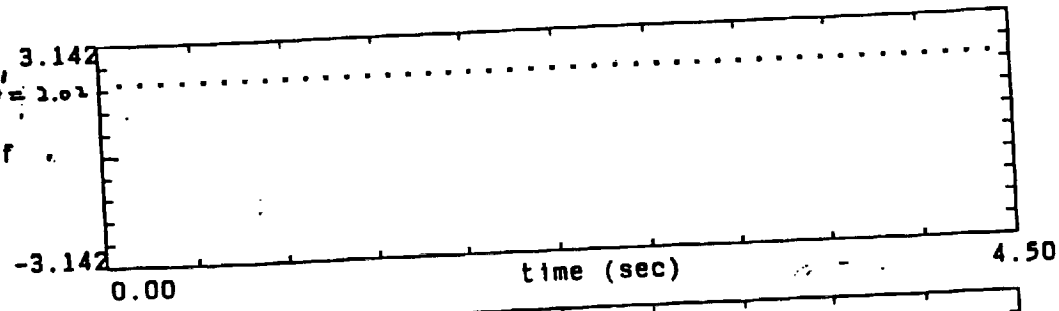




$(\phi = 1.041)$ $\phi' = 1.041$

Phase Diff

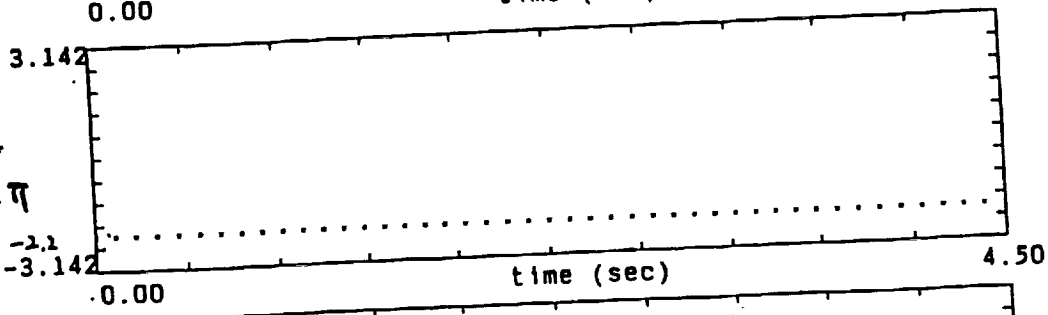
$\phi = \phi'$



Phase Diff

$\phi' = \phi - 2\pi$

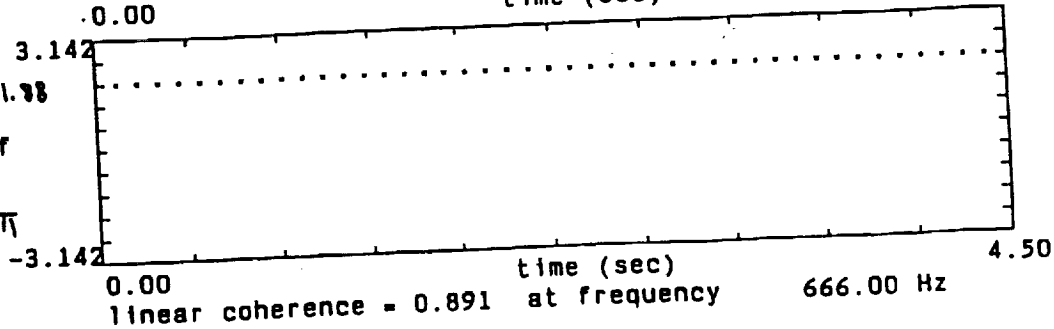
$(\phi = 4.084)$ $\phi' = -2.1$



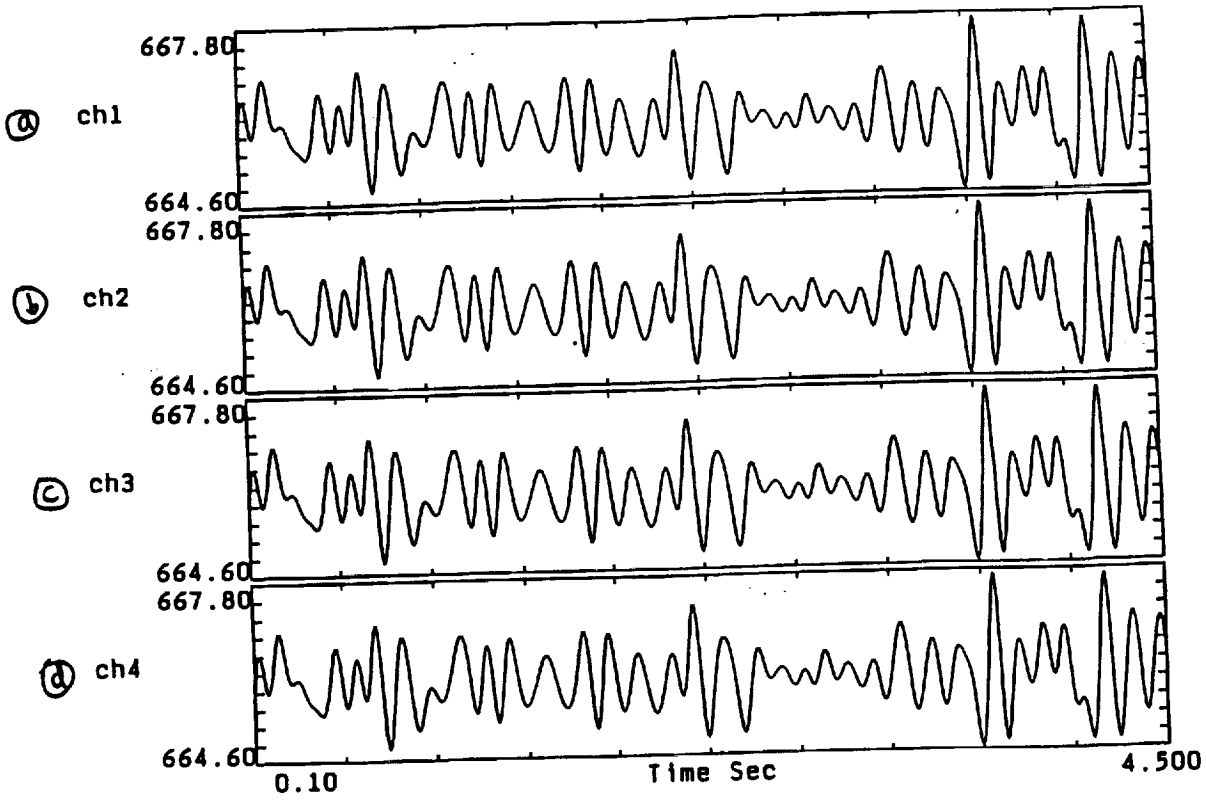
$(\phi = 3.168)$ $\phi' = 1.88$

Phase Diff

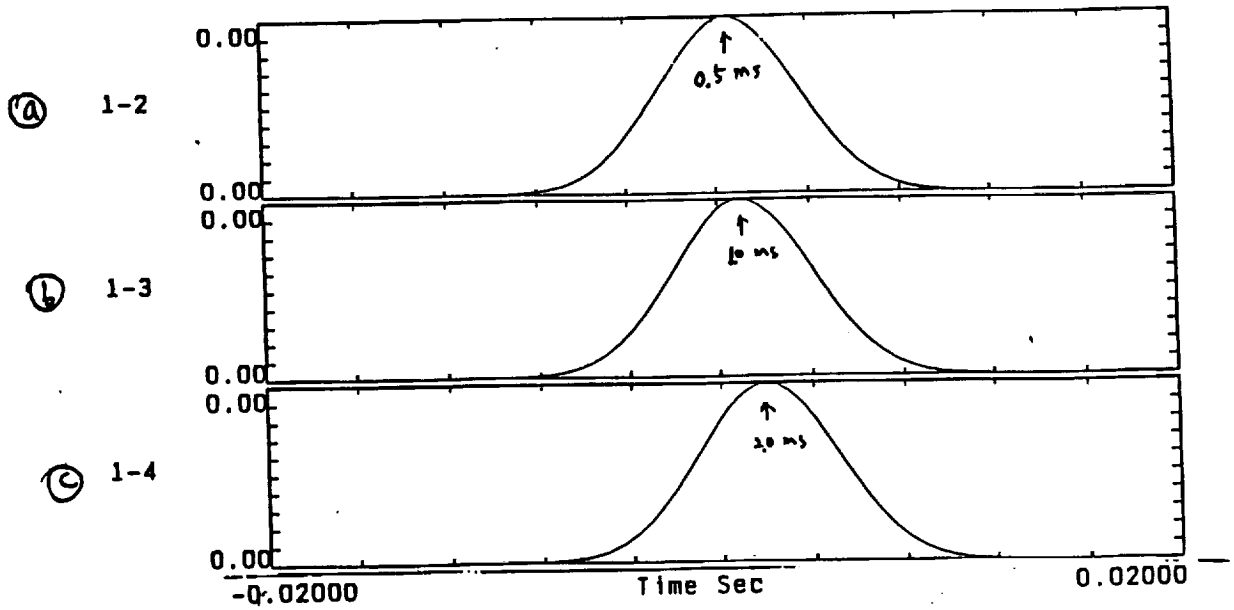
$\phi' = \phi - 2\pi$



linear coherence = 0.891 at frequency 666.00 Hz



GHC IF



Cross-correlation of IF signal
20 x 1024
45 power

NEW SIGNAL ANALYSIS TECHNIQUES FOR ATMS SYSTEM

(3) PSTDE (PHASE SLOPE TIME DELAY ESTIMATOR) METHOD FOR TIME DELAY ESTIMATION FOR SIGNAL WITH LINEARLY VARYING FREQUENCY

FOR A SIGNAL WITH LINEARLY VARYING FREQUENCY:

. PHASE DIFFERENCE IS STILL SUBJECTED TO THE PHASE WRAPPING EFFECT

. SLOPE OF PHASE DIFFERENCE (PHASE SLOPE) IS NO LONGER SUBJECTED TO THE PHASE WRAPPING EFFECT

. THERE EXISTS A RELATIONSHIP BETWEEN THE PHASE SLOPE AND THE TIME DELAY INFORMATION OF THE SIGNAL

. FFT BLOCK PROCESSING (INSTEAD OF INSTANTANEOUS):

= > APPLICATION CONDITION IS LESS RESTRICTIVE THAN IFC

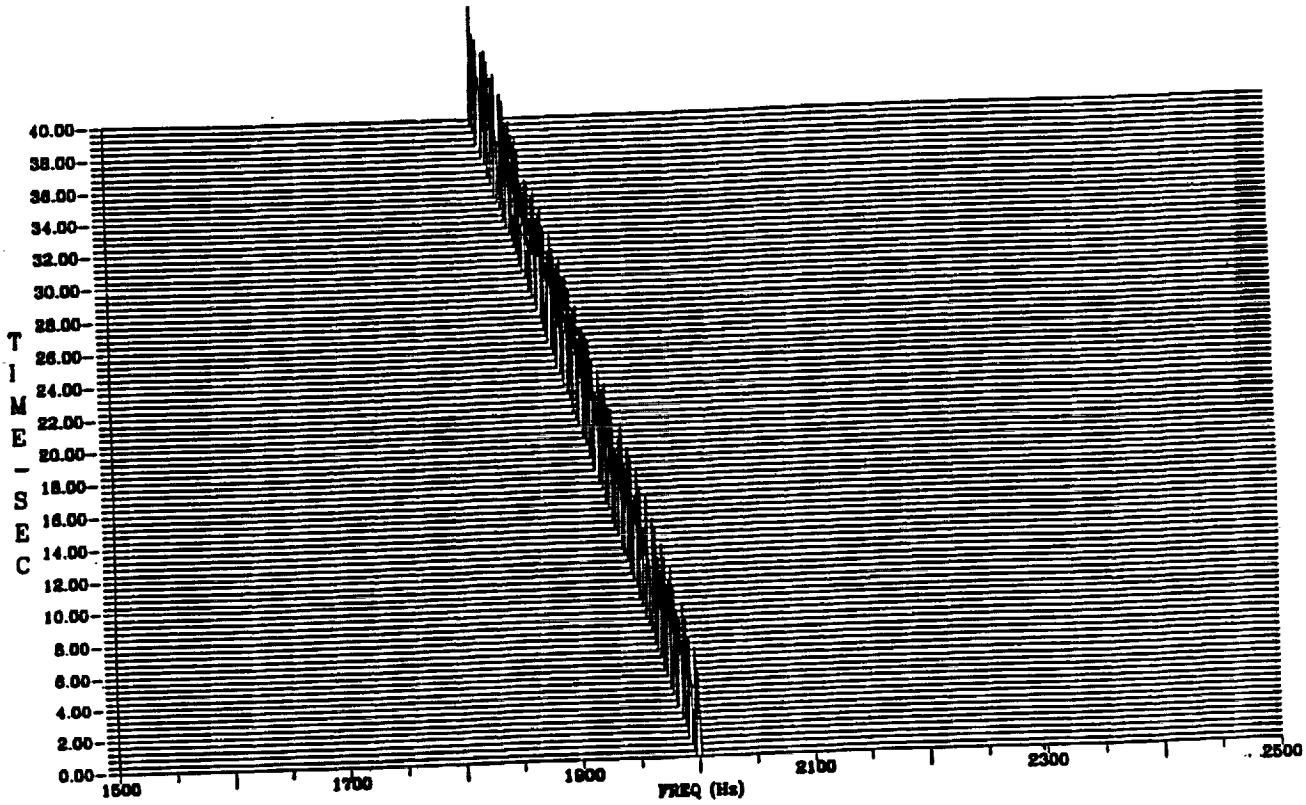
. ONLY REQUIREMENT: FREQUENCY CHANGE LINEARLY

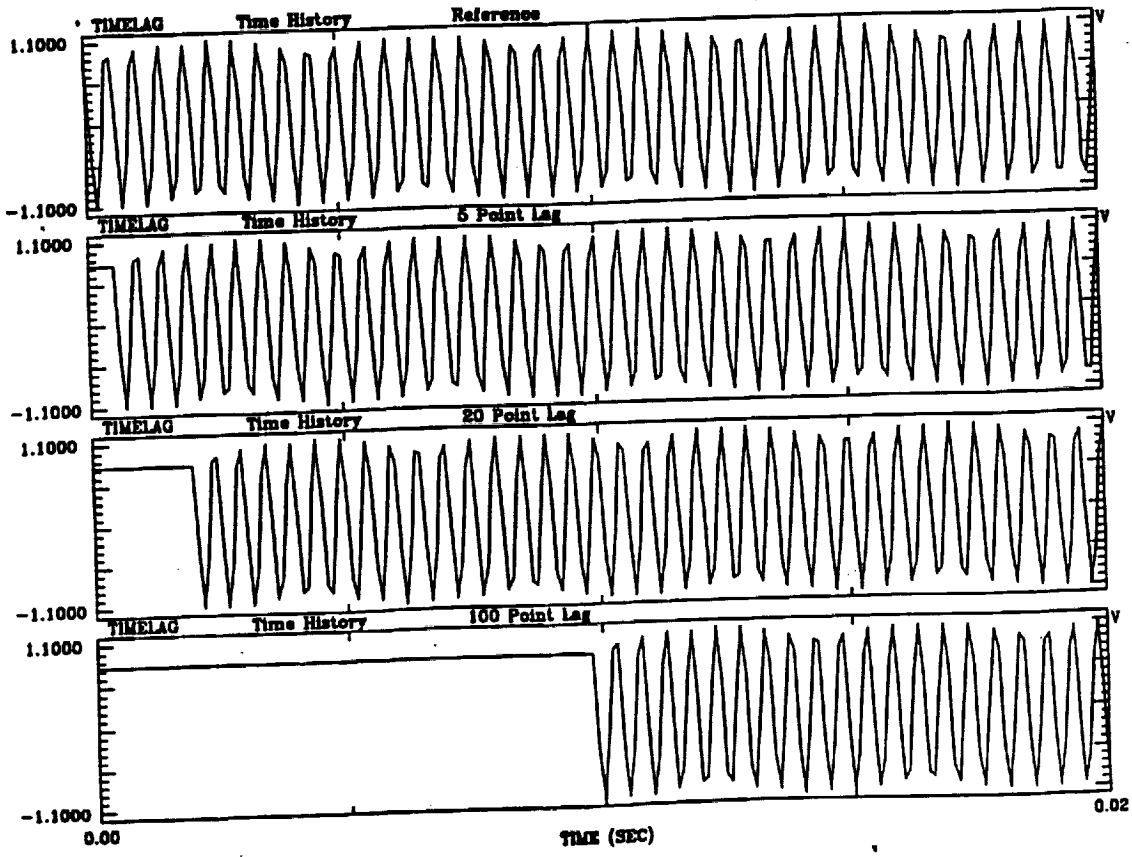
SIMULATION EXAMPLE:

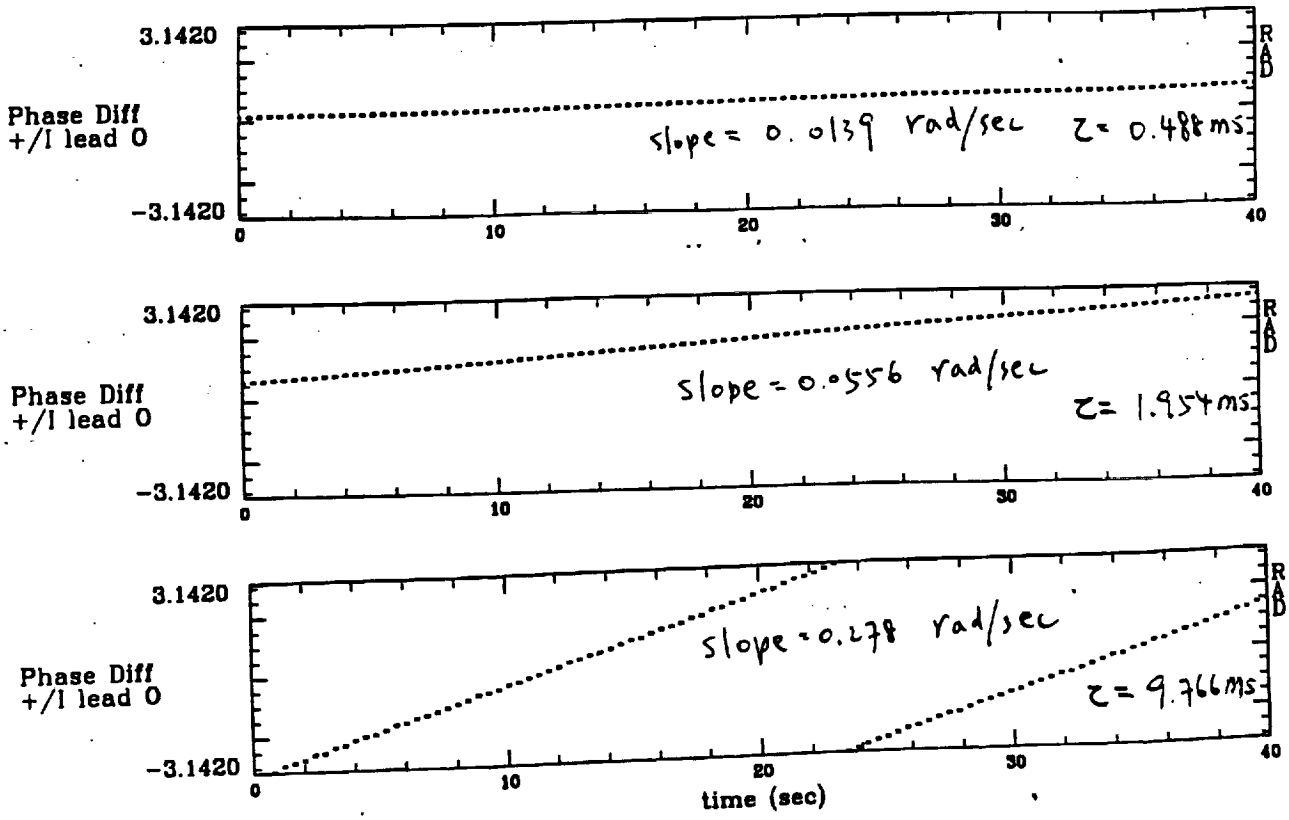
FM signal: $x(t) = \cos[\, 2p\,(0.5\, f\, t2 + fo\, t)\,]$ f0=2000 Hz

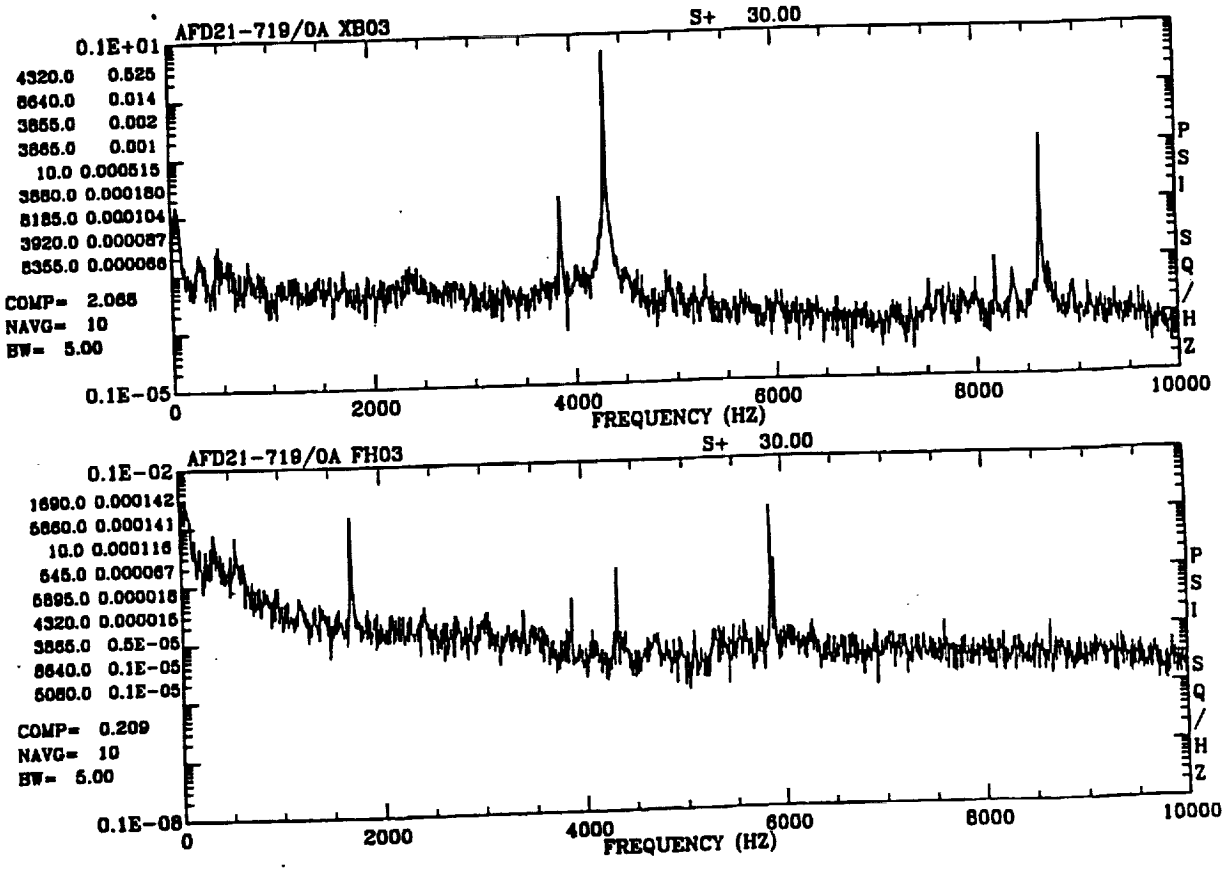
	Ch1/Ch2	Ch1/Ch3	Ch1/Ch4
Time Delay in samples	5	20	100
Time Delay in msec	0.4880	1.952	9.760
Phase Slope (rad/sec)	0.0139	0.055676	0.2788
Time Delay estimated (msec)	0.4882	1.954	9.766

BW= 2.500 TIMELAG Reference 12/22/93
<ED23>
Y-INC=.400E+00 sec
PLOT CLIP LEVEL = .269E+00 V-SQ/Hz LOG/ 77.% Freq. Range =1500.0 - 2500.0

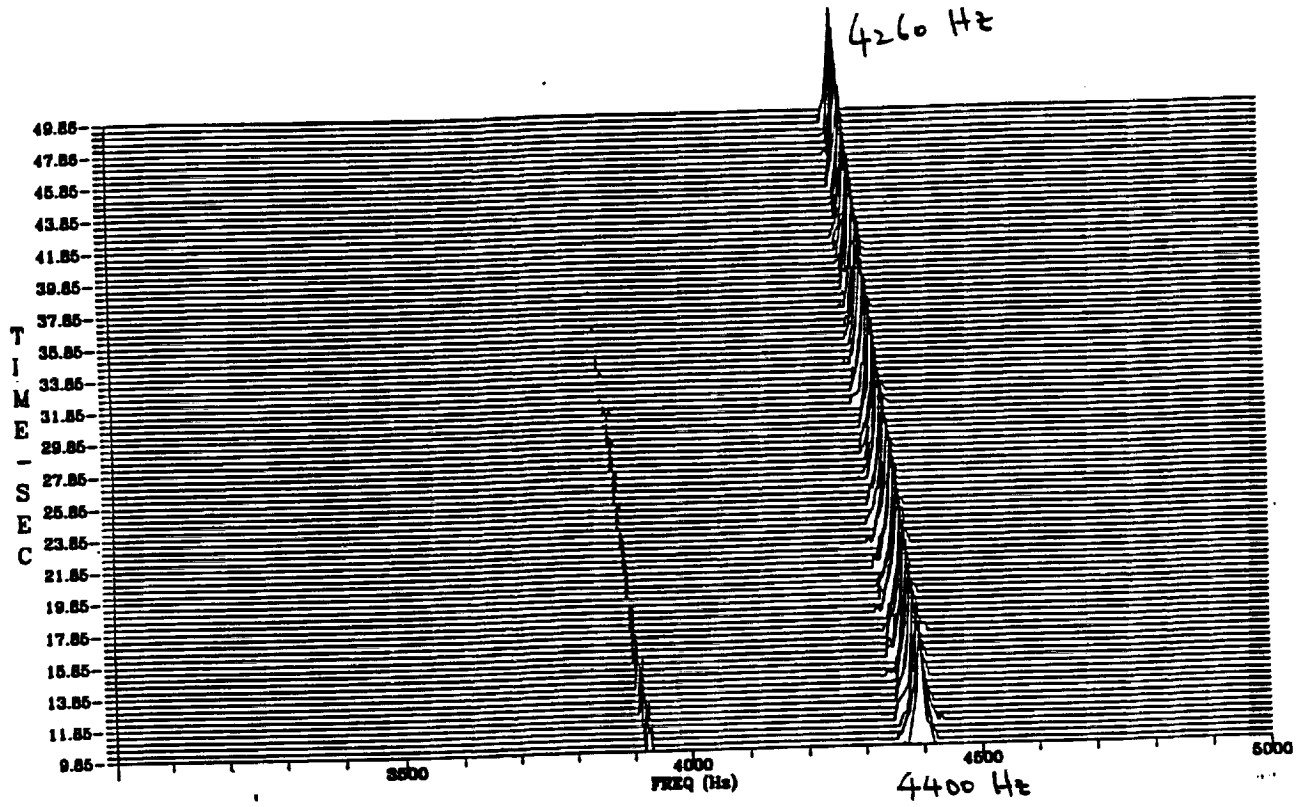


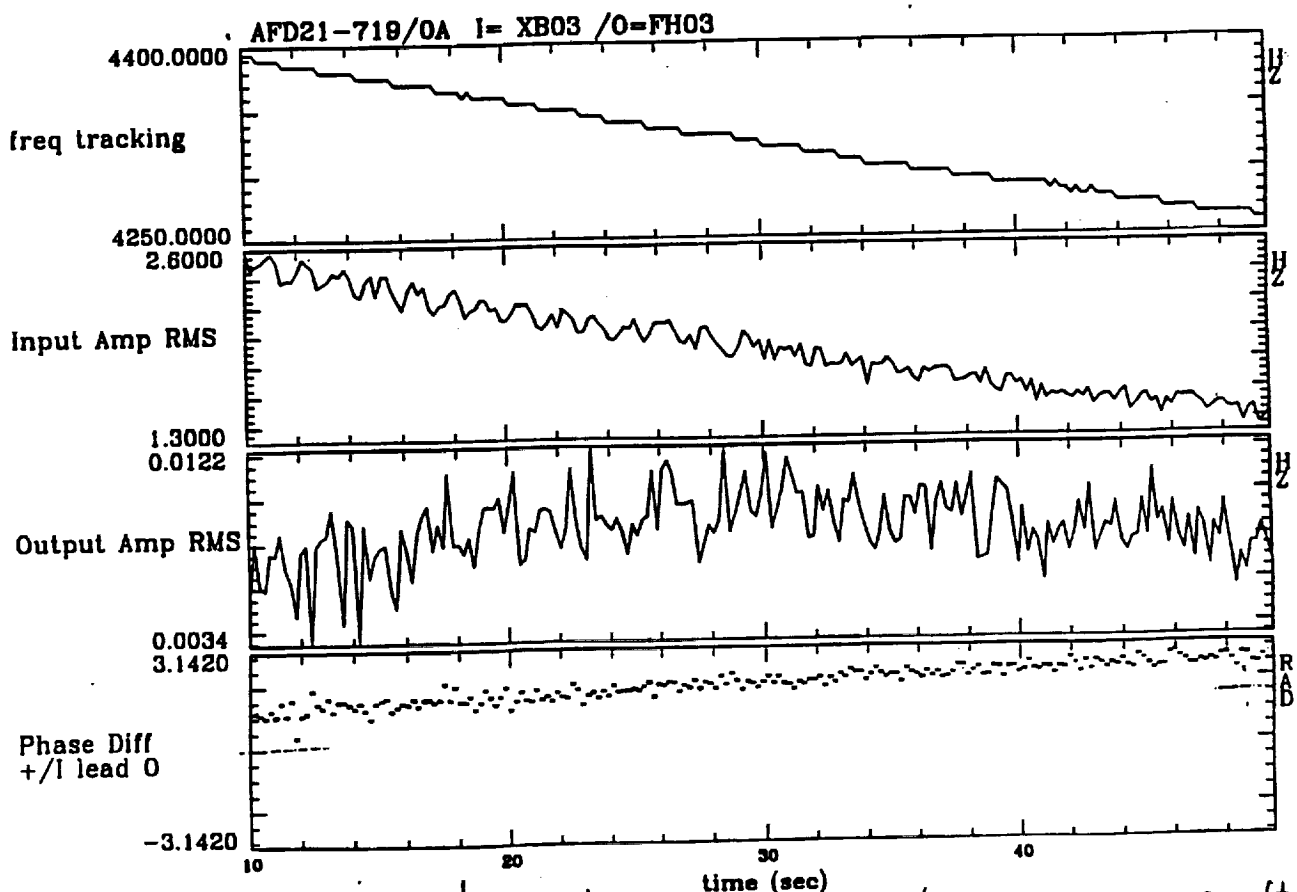



3.1420
Phase Diff
+/l lead 0
-3.1420
0
10
20
30
40
RAD
slope = 0.0139 rad/sec
τ = 0.488ms
3.1420
Phase Diff
+/l lead 0
-3.1420
slope = 0.0556 rad/sec
τ = 1.954ms
3.1420
Phase Diff
+/l lead 0
-3.1420
slope = 0.278 rad/sec
τ = 9.766ms
time (sec)


AFD21-719/0A XB03
S+ 30.00
0.1E+01
4320.0 0.525
8640.0 0.014
3855.0 0.002
3865.0 0.001
10.0 0.000515
3880.0 0.000180
8185.0 0.000104
3920.0 0.000087
8355.0 0.000066
COMP= 2.068
NAVG= 10
BW= 5.00
0.1E-05
0
2000
4000
6000
8000
10000
FREQUENCY (HZ)
PSI SQ/HZ
AFD21-719/0A FH03
S+ 30.00
0.1E-02
1690.0 0.000142
5860.0 0.000141
10.0 0.000116
545.0 0.000067
5895.0 0.000018
4320.0 0.000015
3865.0 0.5E-05
8640.0 0.1E-05
5060.0 0.1E-05
COMP= 0.209
NAVG= 10
BW= 5.00
0.1E-08
0
2000
4000
6000
8000
10000
FREQUENCY (HZ)
PSI SQ/HZ

BW= 4.999 AFD21-719/0A XB03 12/23/93
Y-INC=.400E+00 sec 2 PSDs AVERAGED <ED23>
PLOT CLIP LEVEL = .192E+01 P-SQ/Hz LOG/ 25.% Freq. Range =3000.0 - 5000.0





phase slope = 0.038 rad/sec (C = 1180 ft/s)
time delay = 1.7 msec ⟹ Dist = 2 feet

(2) ANOMALY/FAILURE INVESTIGATION

PURPOSE: PERFORMANCE EVALUATION AND SOFTWARE VERIFICATION FOR ALL THE ANALYSIS PROGRAMS TO BE INTEGRATED WITH THE ATMS SYSTEM

(1) ATD HPOP UNIT 2-3A FAILURE INVESTIGATION

. HIGH TEMPERATURE DELTA-T EXCURSION OCCURRED ACROSS THE PUMP-END BALL BEARING

. LED TO EARLY ENGINE TEST CUTOFF

. THE UNIT IS INSTRUMENTED WITH A PAIR OF XY (90 DEGREES APART) RADIAL SPRING MEASUREMENTS BETWEEN THE HOUSING AND THE BEARING OUTER RACE SLEEVE.

. ATMS SIGNAL ANALYSIS METHODS USED:

- COMB/NOUTCH FILTER: SIGNAL ENHANCEMENT
- STATIC ORBIT ANALYSIS
- DYNAMIC ORBIT ANALYSIS
- GHC ANALYSIS: THE IF OF OBP COMPONENT
- DOUBLE INTEGRATION: DISPLACEMENT

(2) ATD HPOP HIGH SYNC SPIKE ANOMALY INVESTIGATION

. HIGH AMPLITUDE SYNC SPIKES ON EXTERNAL ACCEL

. ATMS SIGNAL ANALYSIS METHODS USED:

- GHC (GENERALIZED HYPER-COHERENCE) FOR IF ANALYSIS
- PSE (PHASE SYNCHRONIZED ENHANCER) METHOD FOR SIGNAL ENHANCEMENT OF CAGE FREQUENCY COMPONENT & ITS HARMONICS
- BI-SPECTRAL ANALYSIS FOR CORRELATION IDENTIFICATION BETWEEN SYNC SPIKE AND ANY OTHER COMPONENTS
- HILBERT TRANSFORM AND ENVELOP DETECTION FOR CAGE COMPONENTS RECOVERY FROM HIGH FREQUENCY SIGNAL

(3) ATMS/EXPERT SYSTEM DEVELOPMENT

- COMPUTER & HARDWARE: SUN/330 SPARC WORKSTATION

  . COMPATIBILITY - ALL THE SOFTWARES ON SUN/300 ARE TOTALLY SOURCE-CODE AND BINARY-CODE COMPATIBLE WITH MSFC OISPS SYSTEM

    - SYSTEM SOFTWARE
    - ANALYSIS SOFTWARE
    - GRAPHICS ROUTINES
    - SSME DATABASE INTERFACE
    - X-WINDOW INTERFACE
    - CLIPS EXPERT SYSTEM INTEGRATION

  . SOFTWARE DEVELOPMENT FOR ATMS SYSTEM WILL BE PERFORM ON THE SUN/330 WORKSTATION.

  . FINAL PRODUCT OF ATMS SYSTEM INCLUDING AMD-DRIVER, ARD-DRIVER, AND CSTDB CAN BE EASILY PORTED OVER TO MSFC OISPS SYSTEM.

- SOFTWARE:

  . ALL SIGNAL ANALYSIS PROGRAMS ON OISPS IN BOTH PRODUCTION MODE AND DEVELOPMENT MODE HAVE BEEN IMPLEMENTED AND VERIFIED ON THE SUN/330 WORKSTATION

  (A) STANDARD UTILITY PROGRAMS:

  . BACKUP
  . MERGE
  . RESAMPLE
  . FILECOPY
  . .
  . .

  (B) STANDARD SIGNAL ANALYSIS PROGRAMS:

  . FFT & IFFT
  . PSD
  . ISOPLOT
  . TRACKING
  . FILTER
  . TIMEPLOT
  . CORRELATION
  . TRANSFER FUNCTION
  . .
  . .

(C) ADVANCED SIGNAL ANALYSIS PROGRAMS:

. Auto/Cross Bi-Spectral Analysis (ABC)
. Auto/Cross Tri-Spectral Analysis (ATC)
. Hyper-Coherence Analysis (HCA)
. PHASE SYNCHRONIZED ENHANCER (PSE)
. INSTANTANEOUS FREQUENCY CORRELATION (IFC)
. PHASE SLOPE TIME DELAY ESTIMATOR (PSTDE)
. Dynamic orbit analysis (DOA)
. Static orbit analysis (SOA)
. Hyper Coherence Filtering (HCF)
. Generalized Hyper Coherence (GHC)
. Composite Modulation Analysis (CMA)
. Hilbert transform (HT)
. Envelop Detection Method (EDM)
. Kurtosis/Skewness moment tracking
. Cepstrum Analysis
. 2D Frequency/Wave-Number Spectral analysis
. Cyclic spectral Analysis
. Wide Band Demodulation (WBD) Analysis
. Rotary Spectral Analysis (RSA)
. Adaptive Comb/Notch Filter (ACF/ANF)
. Adaptive noise cancellation (ANC)
. Adaptive line enhancer (ALE)
. Phase Domain Average (PDA) technique
. TOPO mapping algorithm
. Wigner distribution analysis
. Modified Wigner Distribution (MWD)
. Maximum Entropy Method Spectral analysis

- <u>IMPLEMENTATION OF CLIPS EXPERT SYSTEM</u>

. CLIPS EXPERT SYSTEM IS DEVELOPED BY THE SOFTWARE DEVELOPMENT BRANCH AT NASA JSC

. CLIPS V-6 HAS BEEN IMPLEMENTED ON SUN/330 SYSTEM

. DEVELOPMENT OF AMD-DRIVER: INTEGRATION OF ALL ANALYSIS PROGRAMS WITH CLIPS EXPERT SYSTEM

. BASIC CLIPS OPERATION ENVIRONMENTS AND PROCEDURES HAVE BEEN EVALUATED AND TESTED ON SUN/330 SYSTEM

. EXAMPLE RUNS OF ANALYSIS PROGRAMS SUPERVISED BY CLIPS HAVE BEEN PERFORMED

= = > CLIPS IS A FEASIBLE TOOL FOR THE DEVELOPMENT OF THE AMD-DRIVER.

OBJECTIVE: AUTOMATE DYNAMIC SIGNAL ANALYSIS FOR SSME TEST EVALUATION

1994 CONTRACT SCHEDULES & OBJECTIVES

TASK-1. DEVELOP/REFINE OF NEW ANALYSIS TECHNIQUES:

- PSE (PHASE SYNCHRONIZED ENHANCER) METHOD FOR SIGNAL ENHANCEMENT

- TIME DELAY ESTIMATION METHODS (IFC, PSTDE)

- ADVANCED SIGNAL ANALYSIS TECHNIQUES USEFUL FOR ENGINE DIAGNOSTICS

TASK-2. ANOMALY/FAILURE INVESTIGATION

- PERFORMANCE EVALUATION AND SOFTWARE VERIFICATION

TASK-3. DEVELOPMENT OF AMD STANDARD ANALYSIS DRIVER

TASK-4. DEVELOPMENT OF AMD ADVANCED ANALYSIS DRIVER

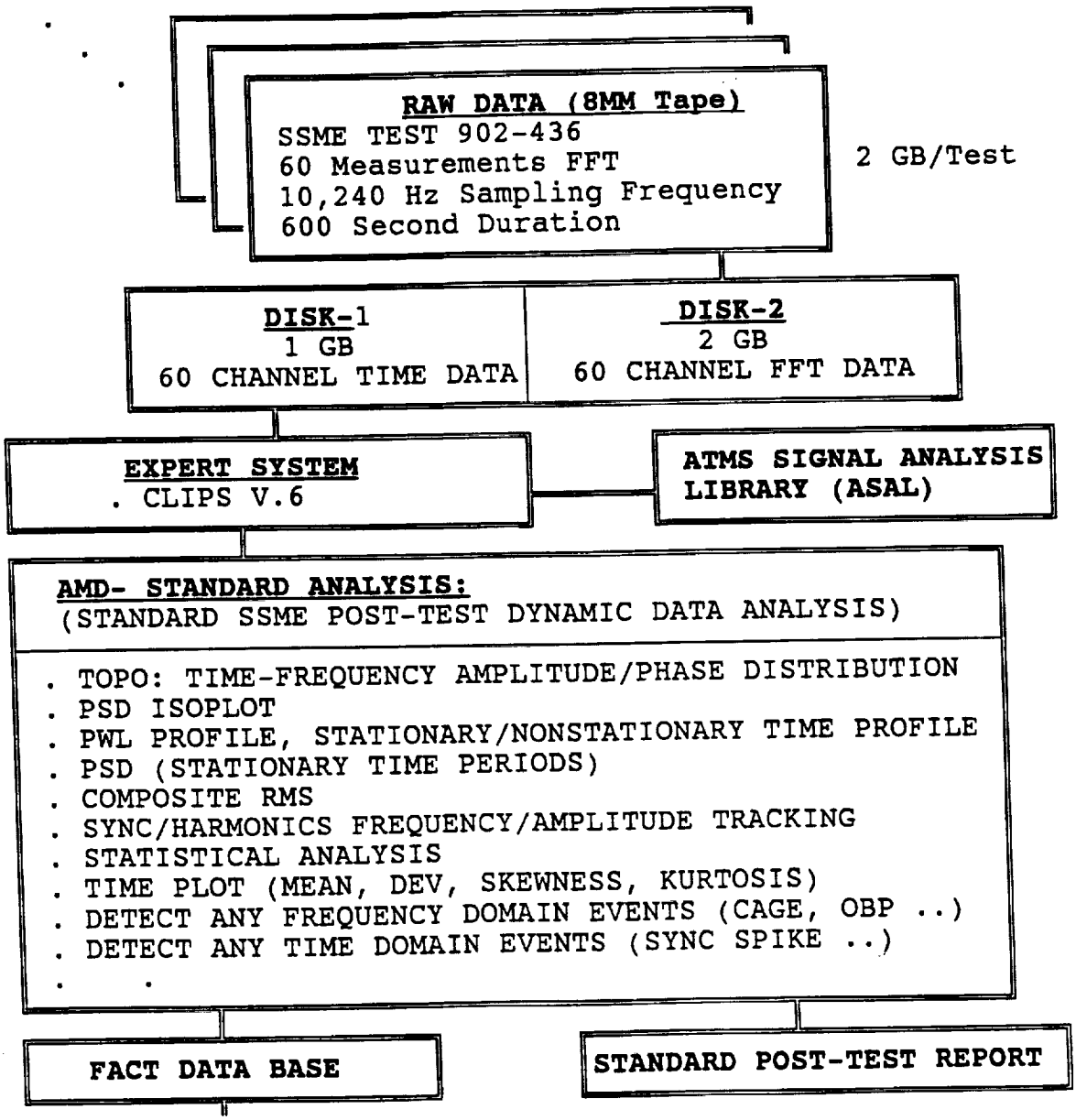
. COORDINATION & RESOURCE REQUIREMENTS

. SCHEDULE AND MILESTONE

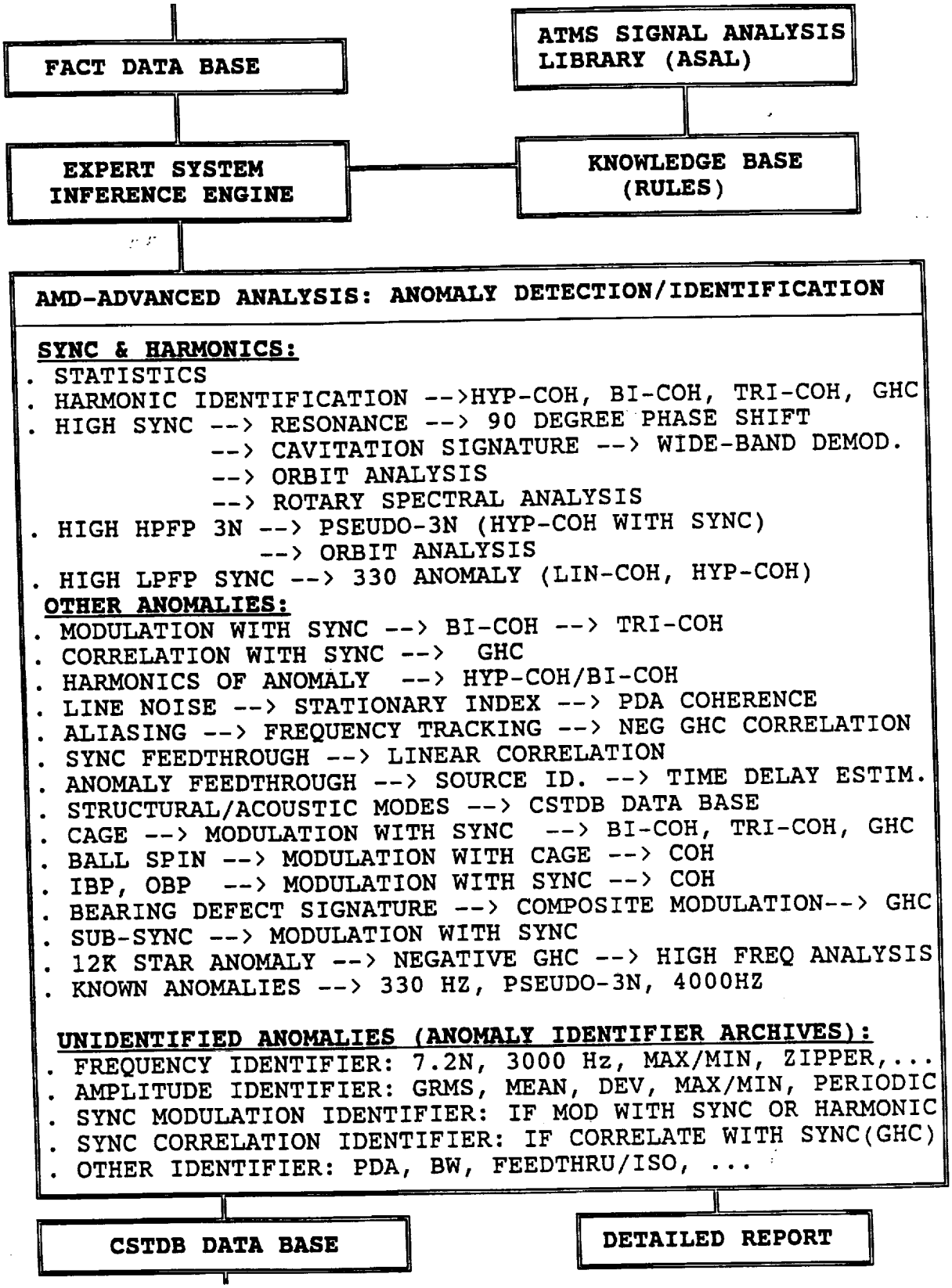
TASK-3. DEVELOPMENT OF AMD STANDARD ANALYSIS DRIVER

OBJECTIVE OF THE AMD-DRIVER:

TO AUTOMATICALLY PROCESS A LARGE SET OF ENGINE TEST DATA IN AN UNSUPERVISED MANNER AND GENERATE A CONCISE POST-TEST REPORT ALONG WITH ALL THE SIGNIFICANT DATA PLOTS. THE AMD-DRIVER WILL ALSO CONVERT THE RAW DYNAMIC SIGNAL INTO A COMPRESSED TOPO FORMAT AND VARIOUS SPECIAL FORMATS TO BE STORED IN THE CSTDB (COMPRESSED SSME TOPO DATA BASE) FOR FURTHER STATISTICAL ANALYSIS IN THE ATMS SYSTEM.



TASK-4. DEVELOPMENT OF AMD ADVANCED ANALYSIS DRIVER



COORDINATION & RESOURCE REQUIREMENTS

COMPUTER DISK STORAGE REQUIREMENT FOR AMD-DRIVER

(1) DISK-1: 1 GB DISK FOR TIME DOMAIN DATA

(2) DISK-2: 2 GB DISK FOR FREQUENCY DOMAIN FFT DATA

(3) DISK-3: 0.5 GB DISK FOR SPECIAL PROCESSING

COORDINATION WITH DATA ANALYST:

. TO ESTABLISH THE OPTIMAL STRUCTURE AND FORMAT OF THE OUTPUT REPORT FILE GENERATED FROM THE AMD-DRIVER

COORDINATION WITH COMPUTER SYSTEM ANALYST:

. TO PERFORM SOFTWARE MODIFICATION IN THE ATMS SIGNAL ANALYSIS LIBRARY (ASAL).

. TO AUTOMATE ALL THE ANALYSIS PROGRAMS TO A NON-USER-INTERFACE MODE, SO THAT ALL THE PROGRAMS CAN BE INTEGRATED WITH AND SUPERVISED BY THE CLIPS EXPERT SYSTEM:

- MEASUREMENT CHANNELS CAN BE SELECTED WITHIN THE EXPERT SYSTEM

- MENU ITEMS CAN BE SELECTED WITHIN THE EXPERT SYSTEM

- ALL ANALYSIS RESULTS CAN BE STORED INTO AN OUTPUT FILES FOR FACT/RULE PROCESSING

- ALL GRAPHICS CAN BE STORED INTO A REPORT FILE

CONTRACT SCHEDULE AND MILESTONE FOR 1994

CONTRACT NO: NAS8-39393
CUSTOMER: NASA, MARSHALL SPACE FLIGHT CENTER
PROJECT: DEVELOP ADVANCED NONLINEAR SIGNAL ANALYSIS TOPOGRAPHICAL MAPPING SYSTEM (ATMS)

AI SIGNAL RESEARCH, INC.	**MILESTONE SCHEDULE**	*DATE: 1/20/94*
	FY 1994	**FY 1995**
TASK DESCRIPTION	**J F M A M J J A S O N D**	**J F M A M J**
Task I: Develop New Method	**XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**	**XXXXXXXXXXXXXXXX**
Task II: Anomaly/Failure Inves.	**XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX**	**XXXXXXXXXXXXXXXX**
Task III: Develop AMD-SA Driver	**XXXXXXXXXXXXXXXXXXXX**	
Task IV: Develop AMD-AA-Driver	**XXXXXXXXXXXXX**	**XXXXXXXXXXXXXXXX**

REPORT DOCUMENTATION PAGE

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11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

(1) A presentation for annual contract progress review was given to MSFC ED-23 personnel on January 21, 1994 to discuss and update the current software development effort for the Advanced Topo Mapping System (ATMS). A number of major contract performance and plans were discussed in the presentation. In reviewing the 1993 contract accomplishment, the development of three new signal analysis techniques for ATMS system were discussed in detailed. These include a signal enhancement method and two time delay estimation methods. Simulation examples along with real test applications were shown to demonstrate the principle and effectiveness of each techniques. In addition, several anomaly/failure investigation effert performed in 1993 were reviewed. Two major anomaly inestigation efforts relating to the ATD...

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17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT